PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

PLANTERS' BULLETIN FORTY-FIVE

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EXPERIMENT STATION AND FACTORY. This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement. There is a guest house.

CORRESPONDENCE. All LETTERS must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special enquiries may be marked for the attention of particular officers. The address for TELEGRAMS is Searching, Kuala Lumpur. TELEPHONE: Kuala Lumpur 72051. PARCELS occasionally arrive without any indication of their origin. Senders' names and addresses should be written clearly on the outside of all packages, and advice of despatch should be given by letter or telegram.

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ADVICE. Enquiries are invited from rubber producers in the Federation of Malaya, Singapore, the colony of North Borneo, and the territories of Sarawak, Brunei and Nigeria, who may require more detailed information applicable to their own special problems. Where it is considered necessary, visits will be made to estates in Malaya as convenient. Visits to estates in other territories are by special arrangement. The only visits for which charges are normally made are those of our clone indentification inspectors. INTERVIEWS should be arranged by letter, as members of the senior research and advisory staff are frequently absent on visits to plantations.

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PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur November 1959 Number 45

Editorial: The B.R.P.R.A. Technical Service

It is in the producer's interest to back his sales with technical advice on how his product is to be used. It follows that the development of an adequate advisory service to the consumer is of special importance to us in a period when natural rubber has to compete with standardised synthetic products which are supported by efficient technical advice.

The research and development organisations* of the natural rubber producing industry have become increasingly aware in recent years of the need for a comprehensive technical advisory service for users of natural rubber. These organisations are well equipped to provide such a service, since they can back it with the skill and experience of research workers and technologists who are available for consultation on specific problems. It is sometimes asserted that the user knows everything he needs to know about natural rubber, but it was already apparent two years ago that manufacturers would be likely to make considerable demands on such an advisory service.

In the latter half of 1958, the British Rubber Producers' Research Association set up a Technical Service. It is guided by a Panel comprising representatives of the B.R.P.R.A., reinforced by the Superintendent of Rubber Technical Developments Limited and a representative of the Natural Rubber Development Board. In the first year of activity nearly 300 visits have been made to rubber users in the United Kingdom, and a large number of enquiries, including many from overseas, have been dealt with by correspondence. Many problems arising in the use of natural rubber by manufacturers have been solved — such assistance is, of course, given in confidential collaboration with works technologists.

A campaign to promote the use of Superior Processing (SP) rubber has been an important feature of the visits so far; but general interest has been evident in B.R.P.R.A. work on improved resistance to heat and to ozone, slowing down of crystallisation, protection against deterioration, and the adaptation of latices containing new types of preservative to suit the requirements of manufacture already based on high-ammonia concentrate.

* particularly the British Rubber Producers' Research Association (B.R.P.R.A.) and the Natural Rubber Development Board (N.R.D.B.)

The value of this direct technical advice is threefold:

1. Personal contact between B.R.P.R.A. staff and the rubber manufacturing industry creates a well-defined channel of communication which enables new developments in natural rubber evolved at B.R.P.R.A. to be brought before industrial technologists.
2. These contacts provide representatives of the producers with an uninterrupted view of the technical scene. Such an insight into the manufacturing industry helps us to decide what lines of investigation, immediate and long-term, call for attention.
3. Contacts with Research Institutes in the East enable the Technical Service to explain to manufacturers the advantages of using new forms of natural rubber (e.g., SP rubber and low ammonia latices) developed in producing countries. Any difficulties which customers experience in the use of rubber and latex can be taken up with producers.

In addition to its activities in the U.K., the B.R.P.R.A. Technical Service is able to provide Natural Rubber Development Board offices in other countries with useful information. In Australia, the appointment of a technologist to assist the N.R.D.B. manager has increased the effectiveness of the service in this respect.

A special kind of technical service is provided to support the 'Rubber in Roads' programme. The N.R.D.B., working in close co-operation with the B.R.P.R.A., will send a representative to advise during the actual laying of rubberised surfaces and will carry out laboratory tests if necessary. A similar task is performed by the Natural Rubber Bureau in the U.S.A. which has a well-equipped Roads Laboratory for testing rubberised road-surfacing materials.

The synthetic materials competing with natural rubber are backed by very extensive advisory service facilities and it would be illogical for us to regard natural rubber as a unique product which can be offered to the users on a 'take it or leave it' basis. The Technical Service has undertaken the task of supporting natural rubber with the kind of backing which its competitors have enjoyed for some time; its first efforts have met with considerable success.

Wind Damage: PB 86 and PBISG Clonal Seedlings

In *Planters' Bulletin 43* we published an article on 'Wind Damage' illustrated with photographs of various types of planting material which had been damaged by wind, including clone PB 86 and PBISG clonal seedlings. In order to dispel any misunderstanding, we should like to make it quite clear that we consider clone PB 86 and PBISG seedlings to be among the planting materials most resistant to wind damage. The photographs of them were included to demonstrate the type of trunk snap which can occur, and to show that no clone or clonal seedling family is immune from wind damage.

Stimulation of the Yield of Rubber Trees as a Routine Estate Practice

FIELD EXPERIMENTS on the use of synthetic growth substances to stimulate yields have been in progress from 1951 onwards: the results obtained now enable us to give recommendations on the use of these substances in routine estate practice. The properties of the available stimulants, methods of applying them, and the response of yields to stimulation under varying circumstances, are discussed below. Finally a suggested schedule is given for tapping and stimulation of buddings and seedlings grown under normal management.

PROPERTIES OF AVAILABLE STIMULANTS

There are at present four proprietary yield stimulants available in Malaya:

Trade name	*Active ingredients*	*Sold by*
1. Flomore	2,4,5-T	I.C.I. (M) Ltd
2. Star Brand	2,4,5-T	Malayan Fertilisers Ltd
3. Stimulex	2,4-D	Guthrie & Co. (M) Ltd
4. Ready Rub	2,4,5-T	Rotterdam Trading Co. (M) Ltd

Flomore and Star Brand stimulants are formulations of similar composition, containing 1% 2,4,5-T, and prepared according to R.R.I. recommendations. They have a greasy appearance and are for application to scraped bark below the tapping cut. They are unsuitable for monthly or bimonthly application above the cut, if users attach any importance to the quality of the renewing bark for future tapping.

Stimulex is a fluid formulation containing 2,4-D in a mixture of vegetable oils. Its stimulating effect is of the same order as that of the 2,4,5-T formulations but it is less injurious to the bark tissue. Stimulex may be applied to tapped bark above the cut at monthly or bimonthly intervals, but overlapping of the areas of bark treated with stimulant must be avoided.

Like the 2,4,5-T stimulants, Stimulex has to be applied to scraped bark if applied below a downward cut. This stimulant needs stirring before use.

Ready Rub contains 2,4,5-T. It is intended to be applied to unscraped bark below the tapping cut and should not be applied to renewing bark above the cut.

Results at present available suggest that Ready Rub is less effective than any of the other stimulants on renewed bark; satisfactory results have been recorded from application to virgin bark during ladder tapping. Ready Rub should be stirred before use.

METHOD OF APPLICATION OF YIELD STIMULANT

On Lightly Scraped Bark below the Tapping Cut

The depth of scraping of virgin bark can be determined by removing first the dead cork, then a thin greenish layer and finally a smooth yellowish layer. This is the correct depth of scraping and is confirmed by the presence of coarse reddish tissue, and in many cases by the appearance of minute drops of latex. On no account should latex ooze out after scraping.

Scraping of renewed bark should not go deeper than the typical reddish layer; it can be done with a stiff steel wire brush which is flexible and does not cause serious wounding. Any hard steel scraper is suitable for use on virgin or thick renewed bark.

The small latex drops (and, if there has been any accidental wounding, the outflowing latex) should be given time to dry before the stimulant is applied; intermingling of the latex with the stimulant should be avoided as this leads to a thick application resulting in swelling, burring and cracking of the treated bark, which may dry up and rot away to the cambium. We therefore recommend scraping in the morning and application of the stimulant in the afternoon or, if rain or other circumstances interfere, the next morning.

If an excessive amount of dried latex covers the bark after scraping this should be removed before the stimulant is applied; but it is better to leave the few beads of latex from properly scraped trees untouched, as removal may cause renewed exudation of latex.

The greasy 2,4,5-T yield stimulants can be conveniently applied with a flat 1½-inch paint brush, provided instructions previously noted have been adhered to; difficulty in application is generally caused by mixing of latex and stimulant. On no account should the compound be heated. Stimulex is, by its fluid nature, easier to apply than the greasy preparations, but like these should not mix with latex. Care should be taken that it does not run down to unscraped bark beneath the strip where it has been applied.

The treated strip of bark must be tapped away within three months after application. The stimulant should therefore be applied to a strip not more than 2½ inches deep on alternate-daily or 2 inches on third-daily tapping of a half-circumference cut. Application should be made thinly and evenly; this can be ensured by allowing one man to rub the painted bark strips with a rag so that any excess stimulant is removed.

One man can scrape either 125 average-sized rubber trees tapped on a low half-circumference cut, or 75 trees tapped on ladder cuts, per day. For painting, a fair task might be 350 trees with low cuts or 250 trees with ladder tapping. Similar tasks can be given to the man who removes the excess stimulant from the painted strips. These figures are meant as a guide only and much depends on the girth of the trees, the height of the cuts and the type of ladder used; these factors also

determine the number of trees which can be treated with a gallon of stimulant. 500 average-sized trees can be treated with one gallon if applications are made below one half-circumference cut per tree.

The total cost of treatment per tree tapped on one half-circumference cut, including labour and material, is between 4 and 8 cents, depending on the size of the trees, the position of the cuts and the type of stimulant used.

On Renewing Bark above the Tapping Cut

We recommend that of the available yield stimulants only Stimulex should be used for this method of application, in which the stimulant is applied at monthly or bimonthly intervals to the thin film of bark left after the preceding month or two months of tapping. A half-inch artist's paint brush is most suitable for this purpose. Application should be made on a non-tapping day and the scrap should not be removed before application, as this would result in mixing of latex and stimulant.

On Unscraped Bark below the Tapping Cut

Of the available yield stimulants, only Ready-Rub gives an increase in yield level if applied to unscraped bark below the tapping cut. When tapping alternate daily, not more than $2\frac{1}{2}$ inches of bark below the half-circumference cut should be treated. Care must be taken that the stimulant, which on a hot day can be a rather thin fluid, does not run down the bark.

AGE AT WHICH RUBBER TREES MAY BE STIMULATED

Normally a rubber tree is brought into tapping between 5 and 7 years after planting or budding. Before the trees are opened for tapping they have a yearly girth increment of some 3 to 4 inches per year. When the trees are opened for tapping, the rate of girth increment is slowed down markedly; several of the modern high yielding clones in particular show very poor girthing on tapping.

It has been shown in an experiment carried out on Prang Besar Further Proof seedlings that application of a yield stimulant to young trees checks growth even more severely. Owing to late dripping, the small extra yield obtained by stimulating such young trees is collected mainly as cup-lumps if no second collection is made. A similar disappointing response to stimulation has been recorded in other experiments on young budded trees, and it appears that young trees should not be stimulated.

Very satisfactory results have been obtained when 18-year-old buddings and seedlings have been treated with a yield stimulant. At this age rubber trees have normally reached or already passed their peak performance, and there is no further build-up in yield level. The rate of growth in terms of girth has levelled off to a small yearly increment. Such trees can be treated with a stimulant, and despite high increases in yield the growth rate is not appreciably retarded. This

has been confirmed in several experiments, one of which has been in progress since February 1952. The use of a stimulant may thus be considered at approximately the eighteenth year of life, when the virgin bark of the low panels of the trees has been tapped away. This does not mean that we recommend this treatment as ordinary estate routine, but if for some reason a temporary increased output is required from the mature areas, such trees may be stimulated without risk to their future performance.

QUALITY OF RENEWED BARK AFTER HALF-YEARLY STIMULATION BELOW THE CUT

One of our experiments has now reached the stage where we can express an opinion on the quality of bark which has been stimulated in the past. We are at present tapping second renewal bark of clonal seedlings which were stimulated when tapped on first renewal bark. Half-yearly application of a yield stimulant to a 3-inch strip of scraped bark below the cut has been continued throughout. The tapping system is S/2.d/2.100%. The second renewal bark of stimulated trees is 1-1½ mm thicker than the bark of the unstimulated control trees. The yield appeared to be quite normal and a good response was obtained to subsequent application of a stimulant which, however, resulted in severe damage to the bark of third renewal — a phenomenon generally observed when thin second renewal bark is stimulated.

These observations have given us more confidence in the use of stimulants, as we now have reliable evidence that a normal yield is obtainable from bark which has renewed after stimulation below the cut at the first renewal stage. The standard of tapping should of course be high, since stimulants aggravate tapping wounds.

QUALITY OF RENEWED BARK AFTER MONTHLY OR BIMONTHLY STIMULATION ABOVE THE CUT

We have already stated that only Stimulex (a 2,4-D formulation) should be considered for this method, which is at least as effective as the ordinary method of half yearly application below the cut when thin renewed bark is being tapped. (However, in virgin bark at high level, or on thick first-renewal bark, the half yearly application below the cut gives a better yield response.) The thickness of the bark treated above the cut is markedly increased by formation of non-latex-bearing tissue in the cork region. If overlapping of the stimulated strips is avoided, the bark may renew quite smoothly without the burring and cracking which occurs when a 2,4,5-T formulation is applied above the cut.

In bark which is smoothly renewed in this way, the latex vessel system is normal and the records of tapping show that the yield capacity is similar to that of untreated control trees. Shallow tapping of this thick renewed bark should not be permitted, as the extra thickness does not contain latex vessels.

RESPONSE TO SUCCESSIVE APPLICATIONS OF STIMULANT

There is a decreasing response to successive applications of a stimulant, which may be largely explained by the position of the tapping cut. If, on clonal seedlings, the tapping cut is low down the stem, the response to stimulation is small regardless of whether the application is the first or has been preceded by earlier applications on the same panel; in the latter case, however, the response is more disappointing and may even be negative (see *Figures 1 and 2*).

A factor contributing to this is that the bark at the lower part of the stem of a seedling tree is usually of second renewal when the tree has reached the age when stimulant should be applied. The first panel of seedling trees is opened at 20 inches from the ground, the second (up to recently) at 30 inches, and the later panels are of even greater height. This results in bark of different renewal on the same panel; the bark of first renewal gives a good response and that of second renewal lower down the stem a poorer response to stimulation.

On high level tapping when the cut moves towards the junction between virgin bark and bark of second, or poor first renewal, the response to stimulant application also shows a downward trend. A highly positive effect is obtained, however, when the actual virgin bark island is stimulated, as the yield of this bark on unstimulated control trees drops to a very low level.

We suggest that when low panels of clonal seedlings are tapped at 67% or 100% intensity, stimulation should be discontinued as soon as the cuts are within 1 foot of ground level.

When high panels are tapped, half yearly stimulation should continue and be intensified to once every three months when the cut is within 6 inches of the junction between virgin and renewed bark.

YIELD INCREASES: REACTIONS OF DIFFERENT PLANTING MATERIALS TO STIMULANT

In general no predictions can be made as to the increase in yield which may be expected after application of a stimulant; much depends on the health of the trees and on local environment. Trees growing under poor environmental conditions do not respond satisfactorily, and it is often from such material that an increased output is desired. Poorly renewed bark of healthy trees also gives a disappointing response. The best results are obtained from well renewed bark, or from virgin bark at high level on trees which are in good heart.

Clonal Seedlings

On clonal seedling trees 20 years old at the time of the first treatment, we have recorded over a period of seven years a total increased yield of 36.5% following half yearly stimulant application to good

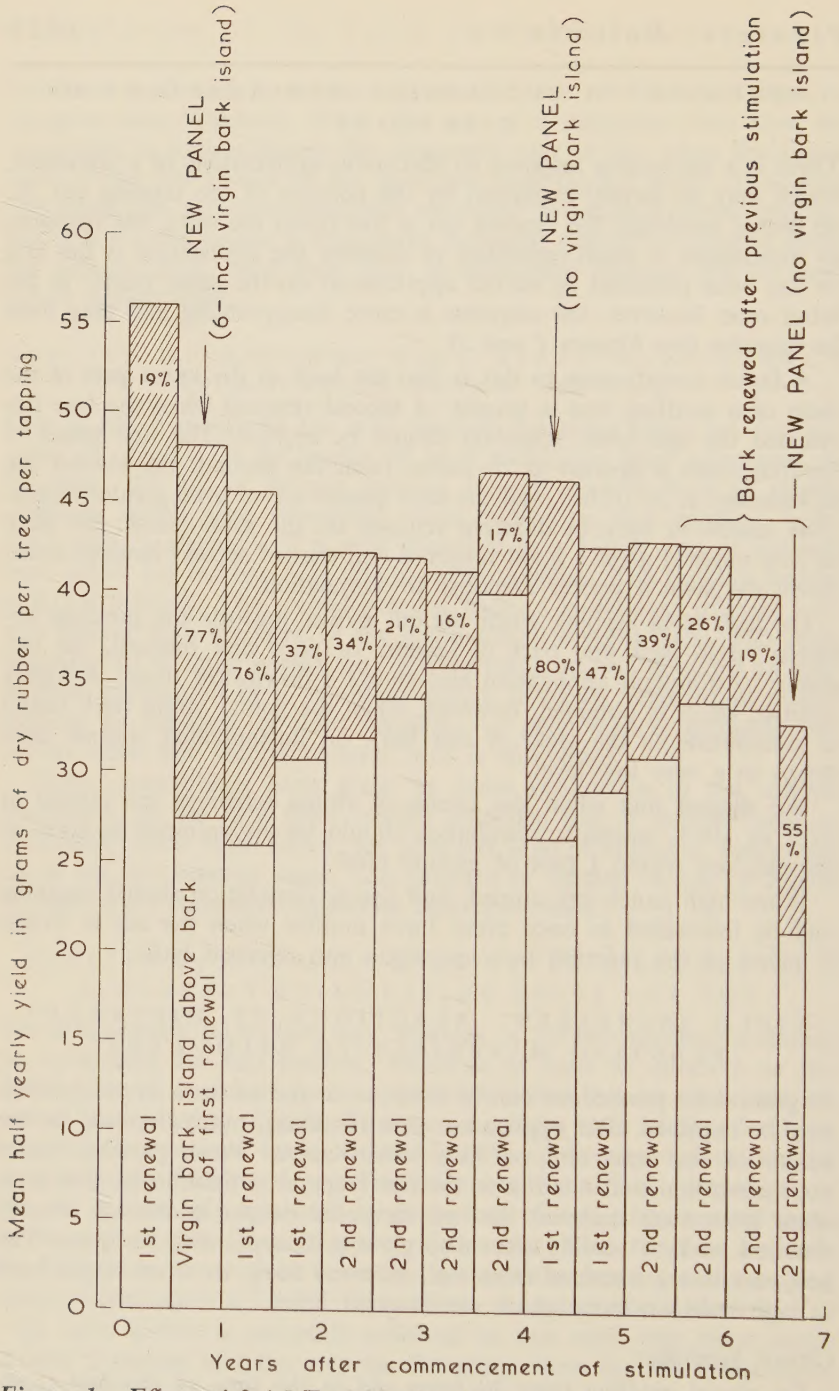


Figure 1. Effect of 2,4,5-T yield stimulant on yield of clonal seedlings, planted December 1931 and tapped S/2. d/2. 100%. Shaded portion shows extra yield obtained by stimulation. Dates of stimulant application were: first, February 1952; second November 1952; thereafter, May and November each year.

bark of first and later of second renewal (see *Figure 1*). The control trees were yielding at the rate of 876 lb per acre per annum, which means that a yearly increase of some 320 lb per acre was obtained at a total cost in stimulant application of less than $12(M) per acre per year.

Unselected Seedlings

Unselected seedling trees tapped on high panels in virgin bark give a similar relative response, but as their actual yield level rarely exceeds 500 lb per acre per year the quantity of rubber obtained through stimulation is less than for clonal seedling trees.

Buddings

In general buddings react favourably to stimulation if tapping is done on high panels or in bark of good renewal. We have recorded an increased yield of 300 lb of rubber per acre per year over a period of five years in an experiment on mixed buddings, planted as budded stumps in 1930. Tapping is done alternate daily on a half-spiral cut in renewed bark, and a stimulant is applied at half yearly intervals. Clone AVROS 50 was the only clone that showed a disappointing response to stimulation under the conditions of this experiment. The evidence is generally not sufficient to demonstrate significant differences between clones in their responses to stimulant application.

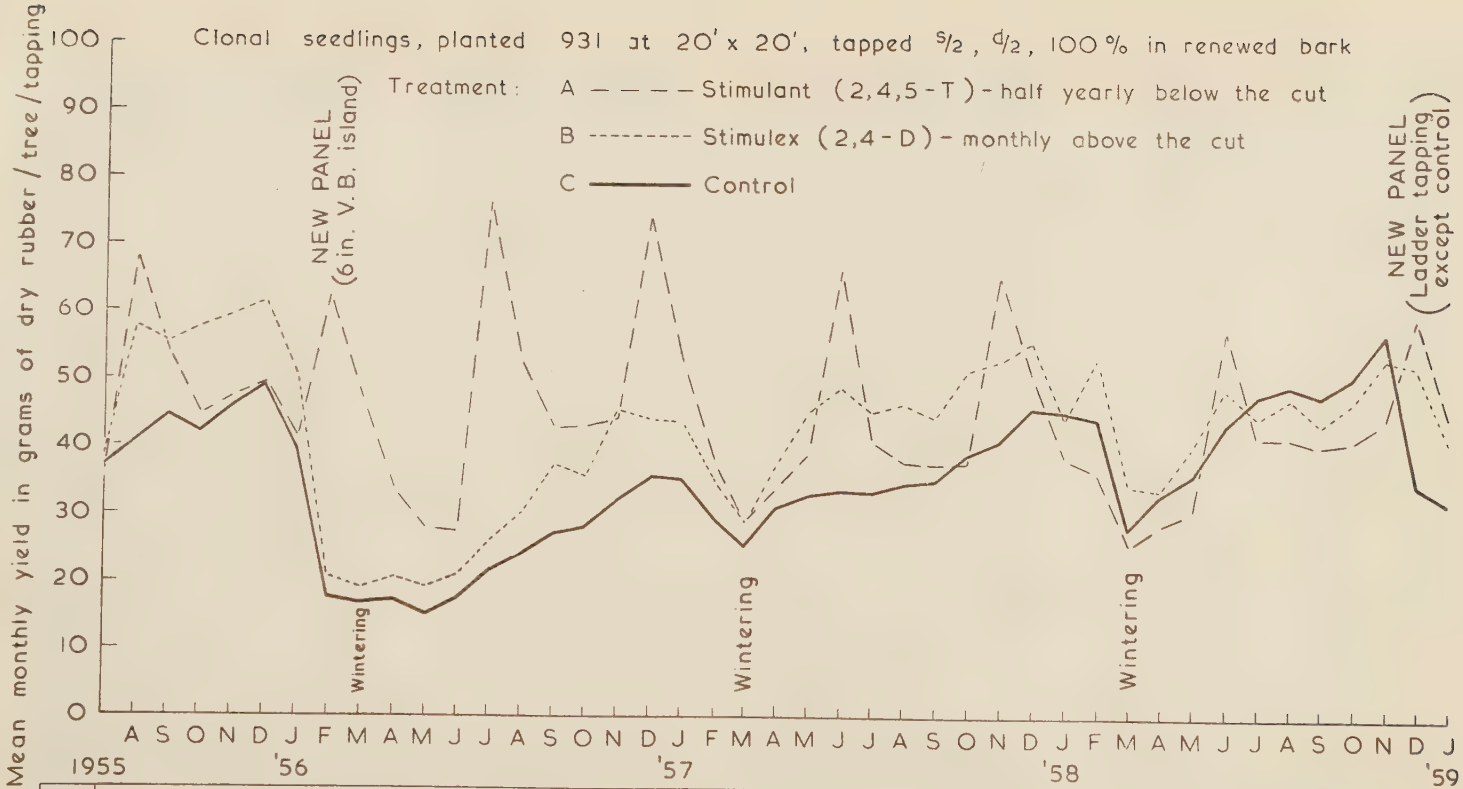
STIMULATION OF LADDER-TAPPED TREES

Rubber trees should not be tapped on high panels if there is good bark of first renewal available at low level. We recommend that all virgin bark and bark of first renewal should be tapped out at normal height before opening trees for ladder tapping.

Experiments have shown that high panels may yield considerably less than low panels of good first renewal bark on both buddings and seedlings. Only if the bark of first renewal is considered too thin for tapping — this rarely occurs under good management — should high panels be opened.

Unselected Seedling Trees

Unselected seedling trees generally yield less when tapped on high panels than when tapped low down the tapering stems in renewed bark of reasonable quality. Ladder tapping of this planting material should therefore, as a routine estate practice, be combined with half yearly stimulant application from the moment the high panels are opened. This holds only for tapping at normal intensity. If sufficient bark reserves are available for a long period of double cut 200% intensity tapping, the use of a stimulant should be postponed until the final 2 – 3 years of tapping (see 'Intensive Tapping of Mature Rubber' in *Planters' Bulletin 38*, September 1958).


Clonal seedlings, planted 931 at 20' x 20', tapped S/2, d/2, 100% in renewed bark
Treatment:
A — — — — Stimulant (2,4,5-T) - half yearly below the cut
B --------- Stimulex (2,4-D) - monthly above the cut
C ——— Control
NEW PANEL (6 in. V.B. island)
NEW PANEL (Ladder tapping except control)
Wintering
Wintering
Wintering
Mean monthly yield in grams of dry rubber / tree / tapping
0
10
20
30
40
50
60
70
80
90
100
A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J
1955
'56
'57
'58
'59

	Relative increases over approximately half-yearly periods						
A	+17%	+137%	+94%	+42%	+26%	+1%	−10%
B	+31%	+21%	+31%	+24%	+35%	+15%	−4%

Figure 2. The effect of two types of stimulation on monthly yields over a period of three and a half years. No stimulant was applied after November, 1958

Clonal Seedlings

There is now evidence that clonal seedlings react more favourably to ladder tapping than do unselected seedlings. The yield on ladder tapping is higher than that obtained when tapping second renewal bark low down the stem; this effect, however, is less striking than in certain clones mentioned below. We recommend application of a stimulant at half yearly intervals when tapping clonal seedlings on high panels.

Clones

A different approach to stimulation of yield should be followed when tapping budded trees on a high panel. Certain clones normally show a large increase in yield when high panels are opened, such as clones PB 186, Pil B84, Pil A44, PB 86 and Tjir 1.

The more recently developed clones have not yet been intensively tested for clonal reactions, since in most of our experiments these trees are still being tapped in bark of first renewal. In one experiment clone RRIM 501 is giving a very high yield on ladder tapping whereas all other clones give an unimproved or reduced yield during the second year of ladder tapping, compared with that obtained from first renewal bark during earlier years.

It appears that clones of high yield capacity when tapped in virgin bark at normal level, will again produce high yields when tapped on high cuts, especially after completion of tapping of first renewal bark at normal height. It is recommended that when high panels are opened on budded trees, no stimulant should be applied for a period of at least three months, so that it can be ascertained whether the particular clone will give a high yield on ladder tapping. If no favourable response is recorded, a stimulant should be applied at intervals of six months. This method has given satisfactory results on practically all clones. Clone PB 25, which in our experiments did not respond well to ladder tapping, has given outstanding yields when ladder tapping has been combined with stimulant application. If yields are high after opening for ladder tapping, we recommend postponement of stimulant application until a well defined downward trend sets in as the cut approaches the renewed bark. The period of high yields is largely determined by the height of opening (see *Planters' Bulletin 43*, July 1959, 'Ladder Tapping of Budded Trees').

THE EFFECT OF TAPPING SYSTEM ON THE RESPONSE TO STIMULATION

Tapping Intensity

Tapping systems of low intensity such as S/2.d/3.67% and S/2.d/2.100% permit a better response to stimulation than do high intensity systems such as 2S/2.d/2.200%, 3C/2.d/2.300% and 2C/1.d/2.400%. The latter 'slaughter tapping' system actually shows a negative response: after a peak yield lasting one month, the yield level drops to a level

far below that of unstimulated trees tapped on the same system (see *Journal of the Rubber Research Institute of Malaya,* 1955, Vol. 14, Communication 296, page 387).

It is shown in *Planters' Bulletin 38* (September 1958) in the article 'Intensive Tapping of Mature Rubber' that when tapping is on a double cut system at 200% intensity (2C/2.d/2.200%), stimulants are effective for only a limited period of $1\frac{1}{2} - 2$ years.

Comparing S/2.d/2.100% with S/2.d/3.67% tapping, it appears that the third daily system gives a better response, but the yield does not equal that of trees tapped alternate daily and also treated with a stimulant. A large saving in tapping costs will nevertheless be achieved by combining third daily tapping of a half-spiral cut with stimulant application.

Periodic Tapping

There is still no conclusive information about the response to stimulation under alternate daily periodic systems. Such systems have been reported to give satisfactory results if the stimulant is applied two to three months after the resting period, so that full advantage is taken of flush yield due to resting.

Daily periodic systems are not considered suitable for combination with stimulant application below the cut. Application of Stimulex above the cut to the bark tapped away during the preceding tapping period may prove satisfactory, but a low d.r.c. is expected at the end of the tapping period and the renewing bark will probably have a wavy appearance.

Full Spiral Tapping

We have not yet tested the effects of stimulants under the full spiral tapping system. This tapping system has largely lost its popularity in Malaya because it interferes badly with girthing in young trees and because it is not conducive to a high standard of tapping.

Reports from estates indicate that a combination of a stimulant with this tapping system may result in bursts in the renewing bark above the cut and 'bleeding' — possibly due to an excessive dose of stimulant. We recommend that not more than $1 - 1\frac{1}{2}$ inches of bark below the full spiral cut should be treated.

Full spiral tapping causes late dripping, and a stimulant is expected to increase this effect.

FURTHER OBSERVATIONS ON RESPONSE TO STIMULATION

Effect of Environment

Trees growing under poor environmental conditions do not respond well. It is often on such material that stimulants are applied in an effort to increase the crop from low yielding fields.

Brown Bast

Brown bast incidence is not increased by the use of yield stimulants. If for some reason a tree goes dry after stimulant application, the treated strip of bark should be shaved away.

Rate of Flow

Yield stimulants give a slight increase in the rate of latex flow, but the duration of flow is greatly increased during the peak yield period. If full advantage of the stimulant is to be obtained a second collection should be made especially during the first month after application, otherwise there may be a high proportion of cup-lump.

Precoagulation

High tapping gives latex of high magnesium content which increases precoagulation. This effect is often attributed to the use of a yield stimulant, as ladder-tapped trees are frequently so treated. However, yield stimulants tend to reduce rather than to increase precoagulation.

Dry Rubber Content

The d.r.c. of the latex declines during the periods when yields are stimulated, but increases again when the yield returns to normal, some three months after application of the stimulant below the cut.

Properties of the Latex

The properties of latex concentrate and dry rubber may be affected to some extent by the use of yield stimulants. The volatile fatty acid (VFA) production in a stimulated latex is about twice that in a normal latex and consequently the use of small additional quantities of anti-coagulants followed by quick processing should be adopted for latex from stimulated trees. VFA formation sometimes gives rise to additional fermentation bubbles in RSS; the addition to the diluting water of 2–4 oz of formalin per coagulating tank is usually enough to correct the increased bubble formation. Stimulation sometimes causes increased enzymic discolouration for a short time after application of the stimulant, and care should be taken when using this latex for preparing pale crepe.

These effects on latex composition are small for tapping near the base of the tree and for low tapping intensities. They are greater for high tapping which gives rise to effects similar to those caused by stimulation. Moreover, VFA content, fermentation bubbles and enzymic discolouration all increase with greater intensity of tapping. More vigorous steps are then required to avoid ill effects which are due partly to the stimulation treatment and partly to the height of the cuts and to the intensity of tapping. These adverse effects are mitigated by the practice of bulking latices before processing, giving a mixture in which latex of normal composition predominates.

SUGGESTED SCHEDULES FOR TAPPING AND STIMULATION OF YIELD

These schedules are represented in diagramatic and tabular form in *Figures 3* and *4*. Roman numbers are assigned to successive phases of tapping both in the schedules below and in the figures.

Buddings — Tapping System S/2.d/2.100%

I. Open the trees when 70% of the stand has reached tappable size at 50 inches above the union. The second panel to be opened at the same height at the opposite side of the trees. No stimulation should be done. This will give 10 years of tapping of virgin bark at normal height (A1 and B2).

II. The third panel (A3) is opened in first renewal bark of the first panel. No virgin bark island should be created. Bark consumption when tapping renewed bark will be slightly greater. No stimulation should be done unless there is an urgent need for a temporarily increased crop. The fourth panel (B4) should be opened in the renewed bark of the second panel with routine half yearly application of a stimulant. The trees are then over 20 years old and will respond favourably without ill effects. A total of 9 years' tapping of first renewal bark may be expected.

III. A high fifth panel (A5), tapped alternate daily, should then be opened above the oldest bark of second renewal at 110 inches from the union. If no favourable response to ladder tapping is observed after three months, a yield stimulant should be applied at half yearly intervals, to be increased to quarterly applications when the cut comes within 10 inches of the junction between virgin and renewed bark. This will give $4\frac{1}{2}$ years of ladder tapping, up to the time when the cut has reached the bark of second renewal.

IV. Tapping is continued into the renewed bark of the low panel (A6), but without stimulation, and at the same time a second high panel (B6) can be opened at the opposite side of the tree. Both cuts are tapped third daily, 2C/2.d/3.133%. A stimulant should be applied to the high cut when the yield shows a downward trend as the cut approaches the renewed bark below. Stimulation should be half yearly at first and later quarterly, and should cease when the high cut crosses into the renewed bark. A period of 5 years of third daily double cut tapping may be expected on these panels.

V. At this stage the trees have been tapped for $28\frac{1}{2}$ years and will be some 35 years of age. Such fields will probably be considered for replanting. There is still bark of first renewal on the two high panels available and one low panel with bark of second renewal. One high (A7) and one low panel (B7) could be tapped

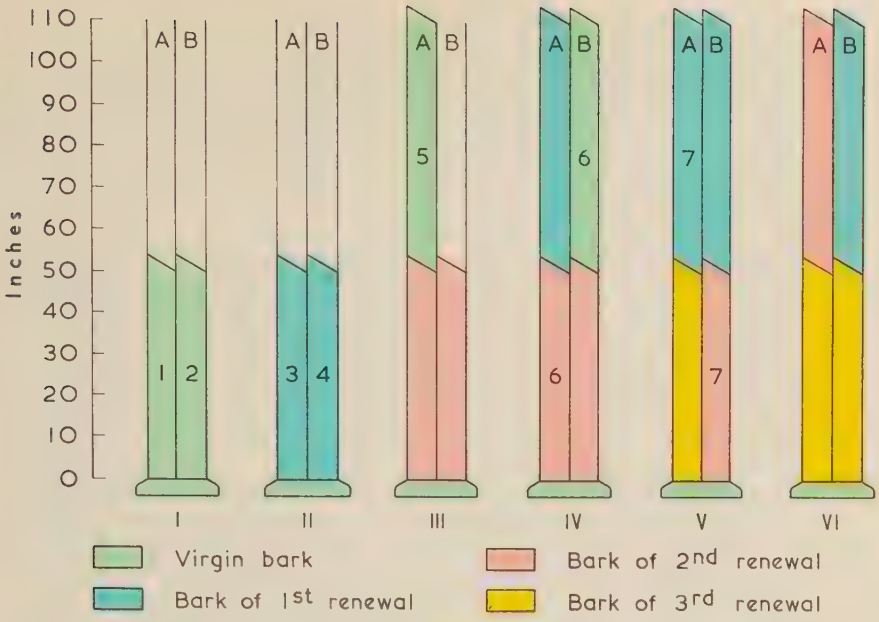


Diagram	*Succession of panels*	*Bark. r.=renewal*	*Tapping system*	*Period of tapping, years*	*Stimulant application*
I	1st, A1	Virgin	S/2.d/2. 100%	5	None
	2nd, B2	„	„	5	None
II	3rd, A3	1st r.	S/2.d/2. 100%	4½	Optional
	4th, B4	„ „	„	4½	Routine, ½-yearly
III	5th, A5	Virgin	C/2.d/2. 100%	4½	Optional. Routine quarterly from 60 in. down to 50 in. (v.b. island)
IV	6th, 2 cuts A6	2nd r.	2C/2.d/3. 133%	5	None
	6th, 2 cuts B6	Virgin	„	5	Optional. Routine quarterly from 60 in. down to 50 in. (v.b. island)
V	7th, 2 cuts A7	1st r.	2C/2.d/2. 200%	4	To both cuts during final 2 years of planting
	7th, 2 cuts B7	2nd r.	„	4	
VI	Gives final bark position of trees				

Figure 3. Suggested tapping schedule for buddings. Panels numbered in order of tapping.

out together in four years of alternate daily double cut tapping (2C/2.d/2.200%) with half yearly stimulant application during the final two years of tapping, leaving another high panel of first renewal.

Seedlings — Tapping System S/2.d/3.67%

I. Open the trees when 70% of the stand has reached tappable size at 20 inches from ground level (A1). Open the second panel at 40 inches from the ground at the opposite side of the tree (B2).

II. The third panel (A3) is opened at 30 inches above the top mark of the first panel, hence at 50 inches from ground level. The fourth panel (B4) is opened in the renewed bark of the second panel at 40 inches from the ground. These four panels together will give a period of 18 years of third daily tapping, during which a stimulant should be used on the fourth panel, and may be used temporarily if the yield drops when the tapping cut approaches the junction of virgin and renewed bark on the third panel. Our experiments have shown a disappointing response to stimulant when the cut approaches ground level on seedling trees; it is advisable to discontinue stimulation when the cut reaches a height of one foot above the ground.

III. When the low panels have been tapped out, a high fifth panel (A5) is opened at 110 inches from the ground, if branching allows, for third daily tapping of a half-circumference cut. This should be combined with half yearly application of a stimulant, to be increased to quarterly application when the cut comes within 10 inches of the renewed bark of the third panel. This will give 6 years of tapping on this panel.

IV. After the cut reaches the renewed bark at 50 inches from the ground, tapping is continued into the low panel (A6) without stimulation, and at the same time a new high panel (B6) is opened. Both panels are tapped third daily (2C/2.d/3.133%). No stimulation should be done until the yield from the high panel starts to drop as the cut moves towards the renewed bark underneath. A period of 5 years of double cut tapping may be expected on these panels. The high cut will then be between 15 and 20 inches above the renewed bark.

V. At this stage the trees have been tapped for 29 years and the area will probably be considered for replanting. As in the case of the budded trees, there is still bark of first renewal on the high panels and also a 15 – 20-inch strip of virgin bark above an uninterrupted panel of second renewal at normal height. One high (A7) and one low panel (B7) can be tapped out together. The tapping intensity may be increased to alternate daily (2C/2.d/2.200%), with half yearly application of stimulant

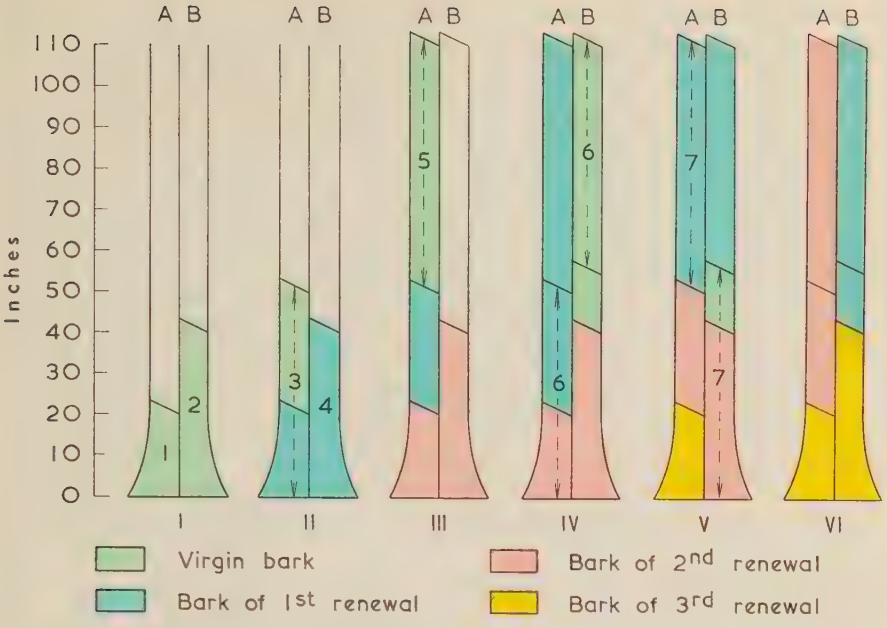


Diagram	*Succession of panels*	*Bark. r.=renewal*	*Tapping system*	*Period of tapping, years*	*Stimulant application*
I	1st, A1	Virgin	S/2.d/3 67%	2½	None
	2nd, B2	Virgin	„	5	None
II	3rd, A3	30 in. virgin 20 in. 1st r.	„	6	Temporary when crossing virgin bark island
	4th, B4	1st r.	„	4½	Routine ½-yearly down to one foot from ground level
III	5th, A5	Virgin	C/2 d/3 67%	6	Routine ½-yearly Quarterly from 60 in. down to 50 in. (v.b. island)
IV	6th, 2 cuts A6	30 in. 1st r. 20 in. 2nd. r.	2C/2.d/3. 133%	5	None
	B6	Virgin	„	5	Optional
V	7th, 2 cuts A7	1st r.	2C/2.d/2. 200%	4½	Quarterly to low cut from 50 in. down to 40 in. (v.b. island): routine ½-yearly to both cuts during final 2 years of tapping
	B7	Virgin and 2nd r.	„	4½	
VI	Gives the final bark position of trees				

Figure 4. Suggested tapping schedule for seedling trees. Panels numbered in order of tapping. Dotted lines indicate full length of tapping panels.

during the final two years of tapping and quarterly application to the low cut as the strip of virgin bark is tapped away towards the bark of second renewal.

These suggested schedules are given as a guide but cannot always be put into effect. If the quality of bark of first renewal is poor, high tapping will have to be done first, followed by tapping of renewed bark. Also if wind damage or root disease curtail the life of a stand of rubber trees, intensive tapping with stimulation will have to be done at an early stage. Economic considerations may also enforce changes of tapping policy. Simultaneous change-over of tapping panels on all trees will greatly facilitate planning of tapping policy and sudden deviations from a fixed schedule. Uniformity in the field is a strict requirement for the proper execution of a programme in which stimulation and a double cut tapping system are combined.

BOTANICAL DIVISION

SP Rubber in Japan

IN 1958, THE R.R.I. SENT SAMPLES of SP rubbers to the Foundation of Natural Rubber Research and Development in Tokyo. These were brought to the attention of the 36th Subcommittee (New Rubbers) of the Rubber Engineers' Association of Japan, which agreed to carry out tests on the new rubbers; the work was to be shared among ten manufacturers of rubber goods. A report on these tests, comparing SP and normal rubber, was published in Japanese in 1958, and the Foundation for Natural Rubber Research has kindly provided an English translation. The conclusions reached are summarised as follows:

1. *Tests in which SP rubbers are superior to normal rubber*

   (i) The raw Mooney viscosity of SP rubber is higher than that of normal rubber. In effect this means that SP rubber has greater initial stiffness and retains its stiffness longer when subjected to prolonged milling.

   (ii) SP rubber shows less shrinkage and has a better surface finish when milled in thin sheets.

   (iii) SP rubber can be more rapidly extruded; it swells less after extrusion and has better surface finish.

   (iv) Compounds unsupported during cure show less sag.

   (v) Expansion after curing in a mould is less.

The above differences are conspicuous in pure gum compounds containing small amounts of compounding ingredients; the advantages are less pronounced where large amounts of compounding ingredients are used. Trial products, which included baseballs and rice planters' socks, showed considerable advantages when made with SP rubber.

2. *Tests showing little difference between SP and normal rubber*
   (i) SP rubber can be mixed in the normal way.
   (ii) Although SP rubber is a little less adhesive the difference is insufficient to influence the finished goods.
   (iii) Values for certain tensile properties are slightly higher in SP, particularly modulus (a measure of the load required to stretch the rubber to a given extent) and hardness, but the percentage elongation required to cause breakage is a little lower.
   (iv) Resistance to abrasion is unchanged.
   (v) Electrical properties are much the same.

3. *Tests showing SP rubber at a disadvantage*
   (i) The Mooney scorch time, a measure of rate of vulcanisation, is shorter.
   (ii) There is inconclusive evidence that SP rubbers show less resistance to repeated flexing.
   (iii) SP rubbers have a lower resilience, a higher heat build-up and a more permanent set after deformation.

This comprehensive series of tests, undertaken by an independent body of rubber users, gives concrete evidence that SP rubbers are of considerable value to rubber manufacturers. Most of the disadvantages listed can be overcome, without losing any of the advantages, by judicious compounding. Japan's use of SP rubber reflects general interest. Current world consumption has almost reached a level of 3,000 tons per year. In the second quarter of 1959, Japan was fifth in the world list of importers of SP rubbers.

Developments in the Propagation of Hevea

BY VEGETATIVE PROPAGATION we can obtain from one selected plant identical individuals which together constitute a 'clone'. Grafting, layering, stooling, and the rooting of cuttings, are methods used in horticulture to establish a clone.

Propagation by seed, even when pollination is controlled, produces variable individuals with characteristics which cannot be forecasted accurately. As a consequence the use of high yielding clones in the form of buds grafted on rootstocks has gained favour over the last thirty years.

EFFECT OF THE ROOTSTOCK ON THE SCION

With many species of fruit trees (apples and pears are examples) the rootstock itself can be propagated vegetatively so that the chosen variety can be grafted on clonal roots; with such species the roots can be selected to influence the growth and fruiting habits of the scion variety. In contrast, selected clones of *Hevea* are at present grafted on seedling roots, because no economic method of producing clonal rootstocks by vegetative means has so far been discovered.

As already mentioned, the root system of many tree species has a profound effect upon the scion. How far this relationship between stock and scion holds good for a tropical tree such as *Hevea* is still not entirely certain. Studies of the effect of seedling rootstocks on buddings indicate that the root system may indeed modify the vigour, yield and latex quality of the scions. It seems likely that selected clonal roots, by reason of their less varied genetic make-up, could affect the scions to an even more marked extent.

The decline in yield which occurs as the tapping panel approaches the union of stock and scion may be partly the result of the stock having a poor yield potential. Records from breeding trials sometimes show disappointing differences in growth, yield and secondary characters between the selected seedling and the second generation buddings derived from it; one explanation might be that the original seedling is on its own roots while its derivatives are on roots of varying origin, some of which may have adverse effects on the budding.

From the foregoing observations we conclude that a clonal rootstock has the advantage of uniformity. The effect of a given rootstock on its scion could be either adverse or beneficial. One possibility which breeders have in mind is that of obtaining optimum performance from *Hevea* by matching buddings with suitable clonal rootstocks.

PROPAGATION BY ROOTED CUTTINGS

The desirability of producing clonal rootstocks which are conducive to optimum performance by buddings has led to attempts to propagate clones from cuttings. A further possibility is that a cutting from a high-yielding clone may give an optimum yield when grown on its own roots, and in this case the clone could be propagated directly *without the necessity for budgrafting.*

A number of attempts have been made in the past to produce clones of *Hevea* by means of cuttings; most have met with little success. Recently new methods, such as the mist techniques, have been successfully evolved in temperate climates for rooting trees and shrubs which fail to respond to simpler methods. It was with such new techniques in mind that a re-investigation of the rooting of *Hevea* was begun about twelve months ago; Mr R.J. Garner, from the East Malling Research Station, was seconded to this Institute for four months and during that time initiated the work described here.

CHOICE OF CUTTINGS FOR ROOTING

An important point which must be borne in mind is that *Hevea*, in common with many perennial plants, especially trees, has a so-called 'juvenile' or immature stage of development followed in later life by a mature stage. How long the juvenile stage lasts or what governs its duration is unknown, but there is evidence that the basal portion of many seedling trees retains certain juvenile characteristics for the greater part of its life.

Figure 1. A group of rooted cuttings in baskets; they include clones GT 1, PB 86, RRIM 605 and WAR 4.

Ease of rooting is a characteristic of cuttings taken at the juvenile stage of *Hevea;* shoots taken from young seedlings root readily. Shoots taken from year-old seedlings and grown in our mist unit (see cover) can be rooted in four or five weeks with a high percentage of success. As the seedling ages this rooting capacity diminishes, and may be lost completely by the time the seedling or its budgrafts can be selected and a clone established. Why this happens is not yet certain; it may be the result of biochemical, nutritional and anatomical changes during development from the young seedling stage.

Leafy cuttings, because of their capacity for photosynthesis, have in comparison with woody cuttings a greater potential for the initiation and growth of new tissues and roots. But they are more delicate to handle and the leaves are quickly shed if they become too hot and dry. Mist propagation largely overcomes these difficulties; the cutting can be kept cool, moist and turgid by the application of water in finely atomised droplets. Kept in such a way cuttings can utilise a degree of sunlight which under dryer conditions would cause severe leaf scorching.

Figure 2. A rooted cutting of RRIM 605.

Currently we are testing the rooting ability of a large number of clones. So far we have found none

that will form roots as readily as will shoots from one-year-old seedlings, and many clones have rooted only in very small percentages. Two clones, however, PB 86 and GT 1, have rooted quite satisfactorily. Rooting of these begins about 40 days after planting, and in some batches 90% success has been recorded. When rooted the cuttings are transferred to baskets containing a specially prepared potting mixture, and after hardening off, provided the original leaves remain healthy, can be ready for planting into the field in two or three weeks (see *Figures 1-3*). We have still to master this technique of 'weaning' the cuttings to withstand dryer conditions after six or eight weeks under mist sprays.

CONCLUSION

Although it remains to be seen whether such rooted cuttings will be acceptable for field planting, we shall watch with interest their subsequent growth, yield characteristics and rooting habit as compared with conventional buddings. Rooting habit is of particular importance as we do not know if the root system produced from a cutting will be as effective as that provided by a seedling. For research purposes we shall be able to provide rooted cuttings and clonal rootstocks of at least a few clones — which will improve the accuracy of many botanical and nutritional experiments, and enable the reaction of stock on scion and scion on stock to be assessed.

Figure 3. GT 1 on its own roots from a cutting; note flowers. The rule is 1 foot high.

In the meantime we shall attempt to improve our techniques. Among the investigations awaiting completion are: determination of the optimum daily duration of misting under tropical conditions; study of the most suitable age and condition of both the selected shoot and the tree from which it is taken; use of nutrient solutions to replace elements lost from the leaves under the mist spray; employment of growth substances. It is to be hoped that the present very short list of rootable clones can be extended when these and other problems of technique are solved.

It is still too early to consider commercial possibilities, but if rooted clones were found satisfactory and could be produced economically it could mean a further advance in the propagation of *Hevea;* budding might become unnecessary or, alternatively, we could select clonal rootstocks on which the appropriate scions could be grafted with advantage.

Correspondence

MECHANISED SPRAYING

One of the most serious disadvantages involved in spraying sodium arsenite with standard tractor-mounted equipment is the excessive wear and tear on the pump caused by the abrasive nature of the solution. This difficulty has now been overcome by substituting for the pump a pressurised tank and a supply of compressed air.

There is nothing novel in this idea, but a suitably designed tank offers several other marked advantages over standard equipment. I must express my thanks to Messrs Henry Waugh & Co. Ltd, Ipoh, for constructing my tank and suggesting some excellent modifications to my original design.

This tank can be used for any liquid, including solutions or suspensions requiring constant agitation. Its chief advantage is that it eliminates blockage of the spray nozzles or of their small individual screens by imperfectly dissolved particles, a frequent cause of stoppages in the field.

Another advantage is that the tank can be charged with a measured quantity of dry arsenic powder straight from the drum, and immediately produces as perfect a solution as can be obtained. This reduces contamination of equipment (mixing drums, buckets, etc.) to an absolute minimum. Whatever method is adopted for supplying the necessary water (see my letter in *Planters' Bulletin 20* of September, 1955), the equipment is not contaminated and can safely be left in the field overnight, thus minimising transport from and to the Poison Store.

A brief description of the equipment may help to support these wide claims. An air compressor is mounted on the tractor behind the driver's seat, and driven from the belt pulley take-off. A transport box is mounted on the hydraulic lift, and in it are carried the tank and the day's supply of arsenic. The compressed air is discharged at the bottom of the tank, creating continuous and violent turbulence in the solution. The quick-action filling cap is fitted with a coarse screen, into which the arsenic powder is thrown. Most of this is dissolved by the filling water, and the remainder rapidly broken up and dissolved by the violent turbulence mentioned above. The offtake pipe is enclosed in about three square feet of very fine mesh screen. A number of safety devices are incorporated.

N.S. Maccoll,
Manager
Suffolk Estate
Sitiawan, Perak.

Mr Maccoll's letter will be of interest to readers who have had trouble with blocked nozzles and screens, when applying sodium arsenite and other chemicals which are not easily dissolved or held in suspension.—Editor

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STYLOSANTHES GRACILIS AS A GROUND COVER

Readers may be interested in the following letter from the Rubber Research Institute of Ceylon on the subject of Stylosanthes gracilis *as a ground cover in rubber plantations, together with the reply from our Botanical Division —Editor*

In our Advisory Circular No. 56, page 5, we have described *Stylosanthes gracilis* as follows:

'This legume is usually used

as a constituent in tropical pastures. It is a vigorous perennial with a strong root system, and competes with the rubber in young clearings.'

The only advantage of *Stylosanthes* is in its drought resistant qualities. It is by no means an ideal cover for young replanted clearings. Its growing habit is too sparse for a satisfactory ground cover compared with the luxuriant growth of *Pueraria.* From observational data on growth conditions it is evident that this cover can compete strongly with young rubber, especially in clearings where insufficient attention is given to its removal along the planted rows of rubber and to periodical slashing to give a surface mulch.

Our present attitude is to discourage the use of *Stylosanthes gracilis* as a ground cover in rubber plantations.

Botanist,
Rubber Research Institute
of Ceylon.

The Department of Agriculture here confirms the drought resistant properties of this species and its deep rooting habit. Thus it may well have first call on water reserves in the soil and be competitive in rubber plantings. It is possible that this would be most pronounced in north Malaya and other parts where the climate is seasonal, but that there would be no serious effects where an equitable distribution of rainfall prevails, as in the south.

However, we shall bring these matters to the attention of all concerned and advise that *Stylosanthes* be used for trial and observation on a limited scale only.

Botanical Division
Rubber Research Institute
of Malaya.

Revision of Planting Recommendations 1959-60

On advice from Prang Besar Estate it has been decided to delete clone PB T 207 from Class III (clones recommended for experimental scale planting) of the Planting Recommendations given on page 5 of *Planters' Bulletin 40,* January 1959.

This clone has shown considerable susceptibility to wind damage and is not now considered suitable for such use.

Tree Poisoning with 2,4,5-T

When 2,4,5-T was first used for poisoning trees before replanting it was not uncommon to hear of its partial or complete failure, necessitating repoisoning with sodium arsenite. We accordingly set out to improve the performance of 2,4,5-T, making it more reliable as a tree poison.

We are aware that scrap rubber on the surface of the bark interferes with the absorption of poison; also that it is less effective if applied to wet trees. Furthermore, spraying the solution instead of brushing it on appears to give somewhat inferior results. There have been indications in our experiments that exposed wood above the poisoned region interferes with movement of 2,4,5-T in the tree. However, although small differences in effectiveness were associated with variations in concentration, dosage, region of application on the tree and with certain additives, it was found that brushing 5% 2,4,5-T in diesel fuel oil on to the bottom 15 inches of the stem always killed the trees.

To progress with this investigation we need to study instances where the poison has failed. Planters who have used 2,4,5-T for clearing old rubber this year, and have obtained unsatisfactory results with it, are therefore asked to inform us so that we may visit the areas concerned and attempt to trace the cause of failure.

RRIM 500 and 600 Series Clones, Clone LCB 1320 and Exchange Clones: Sale and Export

RRIM 500 Series and Clone LCB 1320. Readers are reminded that as from 1 January 1955, the Board of the Rubber Research Institute of Malaya removed all restrictions on the sale of budwood of the RRIM 500 series clones in Malaya, British North Borneo, Sarawak and Brunei. All the agreements relating to budwood of these clones were cancelled at that date and producers are now free to purchase or sell the budwood within the territories noted above.

By agreement with the Board of the Centrale Proefstations Vereniging, the Board of the Rubber Research Institute of Malaya also freed clone LCB 1320 as from 30 June 1955, within the same areas.

Some, or in some cases all, of these clones are handled by Agents appointed by the Rubber Research Institute in countries and territories other than those noted above. In these countries, apart from exports at our request or that of our agents, export of budwood of the clones named above is not permitted by the Controller of Rubber.

R R I M 600 Series. Clones RRIM 600 to 630 are on general sale under agreement throughout Malaya. They are also handled by Agents in other territories contributing to the Rubber Fund, namely Borneo, Sarawak and Brunei. The Controller of Rubber does not permit organisations other than the R.R.I. to export RRIM 600 clones from Malaya.

Exchange clones. Export of all clones obtained by Malaya under International Agreement is forbidden by the Controller of Rubber. Clone GT 1, which is recommended for moderate scale planting, belongs to this group.

R. R. I. News

Dr B.R. Buttery assumed duty in August 1959 as Botanist. He will work on problems of planting practice. In 1954 Dr Buttery graduated with Honours in Botany at the Imperial College of Science and Technology, London University. Subsequently he carried out research at Southampton University into competition between marshland grasses, and his thesis on this subject has been accepted for a Ph.D. degree. Immediately before coming to Malaya he spent four months at East Malling Research Station, Kent, where he studied experimental techniques in connection with tree crops, particularly recording-practices.

o

Mr C.Y. Ross joined the staff of R.R.I. Experiment Station as assistant manager in October. He has had experience in forestry in Scotland and spent two years at the Royal Botanic Gardens, Edinburgh. Since 1953, Mr Ross has been planting on Carey Island.

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